E85 and Flexible Fuel Vehicles

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Office of FreedomCAR and Vehicle Technologies
Fuels Technologies Subprogram
Non-Petroleum Based Fuels Activity
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Agenda

- Ethanol and Ethanol Blends
- Flexible Fuel Vehicles
- Conversions
- Considerations for E85 Use
- Lifecycle Analysis
- Vehicle Emissions

Ethanol and Ethanol Blends

- Alcohol-based fuel produced from starch crops or cellulosic biomass such as trees and grasses:
  - Currently, corn is primary feedstock
  - Cellulosic feedstock in development
- High octane (100+):
  - Used to enhance octane of gasoline (E10)
  - As oxygenate to reduce CO emissions during combustion (E10)
- As an alternative fuel, most commonly used in a summer blend of approximately 85% ethanol and 15% gasoline (E85). Winter blends may be as low as 70% ethanol.
- E85 has 27-36% less energy content than gasoline so mileage is adversely affected. OEM's estimate 15-30% decrease in mileage.

Flex Fuel Vehicles (FFVs)

- Flex fuel vehicles can use E85, unleaded gasoline or any combination of the two.
- Key component differences in a flex fuel vehicle are:
  - Higher volume fuel pump
  - Larger diameter injectors
  - Different materials in the fuel system, heads, valves, and piston rings
  - ECU calibration
- Conventional vehicles are not certified for use with E85
- If E85 is used in a non- flex fuel vehicle the driver will experience very poor acceleration, a substantial increase in maintenance costs, eventually component failure
- FFVs are available in light duty vehicles including cars, vans, ½ ton pickups, and SUV's. There are an estimated 5 million FFVs on the road in the U.S.

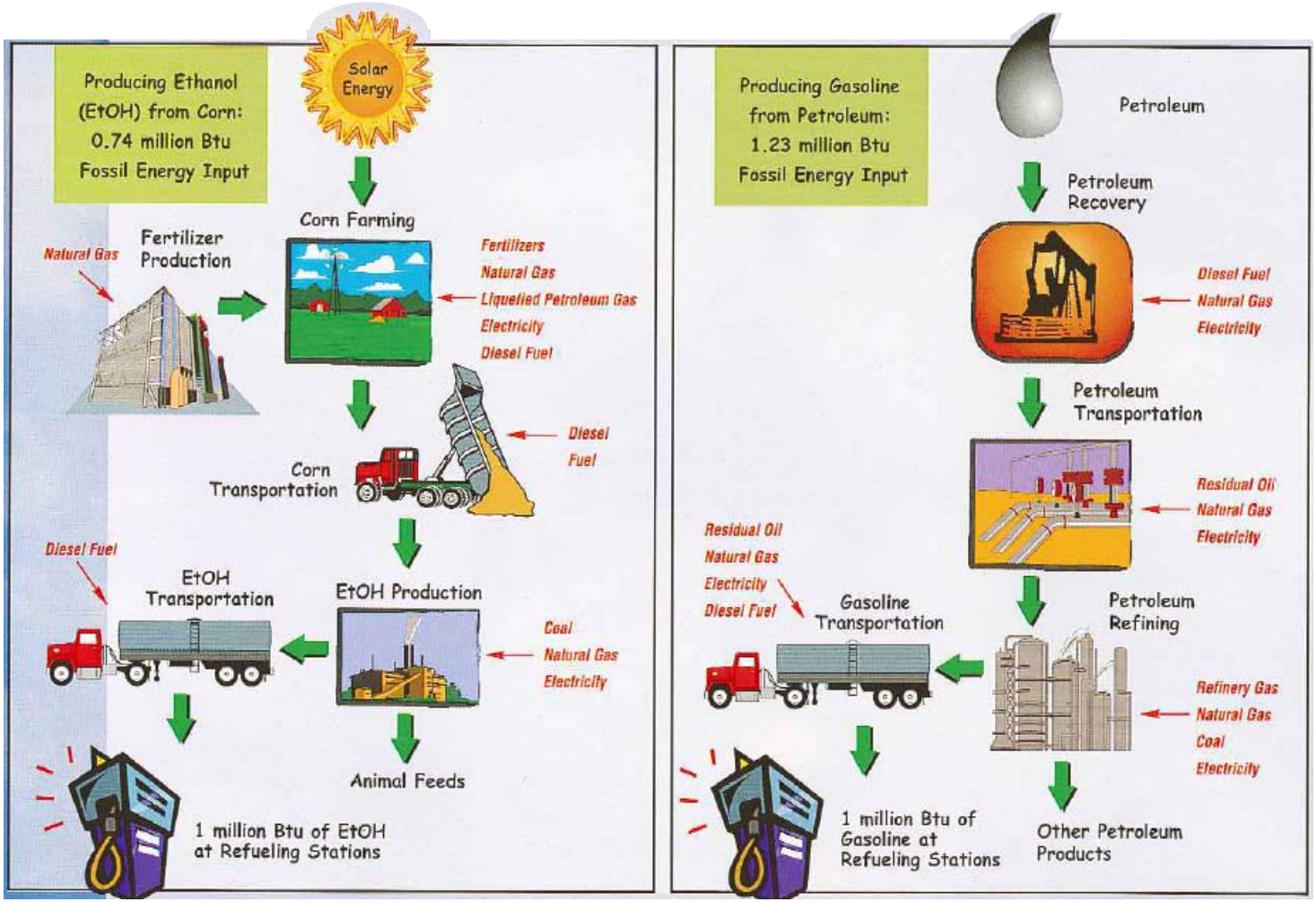
FFV Conversions

- FFV conversions are considered “Aftermarket Conversion Systems”, not just “Devices” and therefore are required to obtain a Certificate of Conformity
  - The same emission certification required of a new vehicle
- Currently no conversion kits are approved by the EPA.
  - To date none have obtained a Certificate of Conformity. Two are in the approval process.

Points to Consider for E85

- Decreased mileage and range when using E85
- High level of fuel pricing volatility until demand and supply balance
  - Needs to cost 20%-30% less to make economic sense
- Refueling infrastructure not in place in all geographies. Currently there are approximately 1200 stations in the U.S. offering E85.
- Colorado currently has 20 stations with 50 projected by end of 2007.
- Controversy in press over life cycle energy balance and greenhouse gas emissions
- Limited tailpipe emission data.

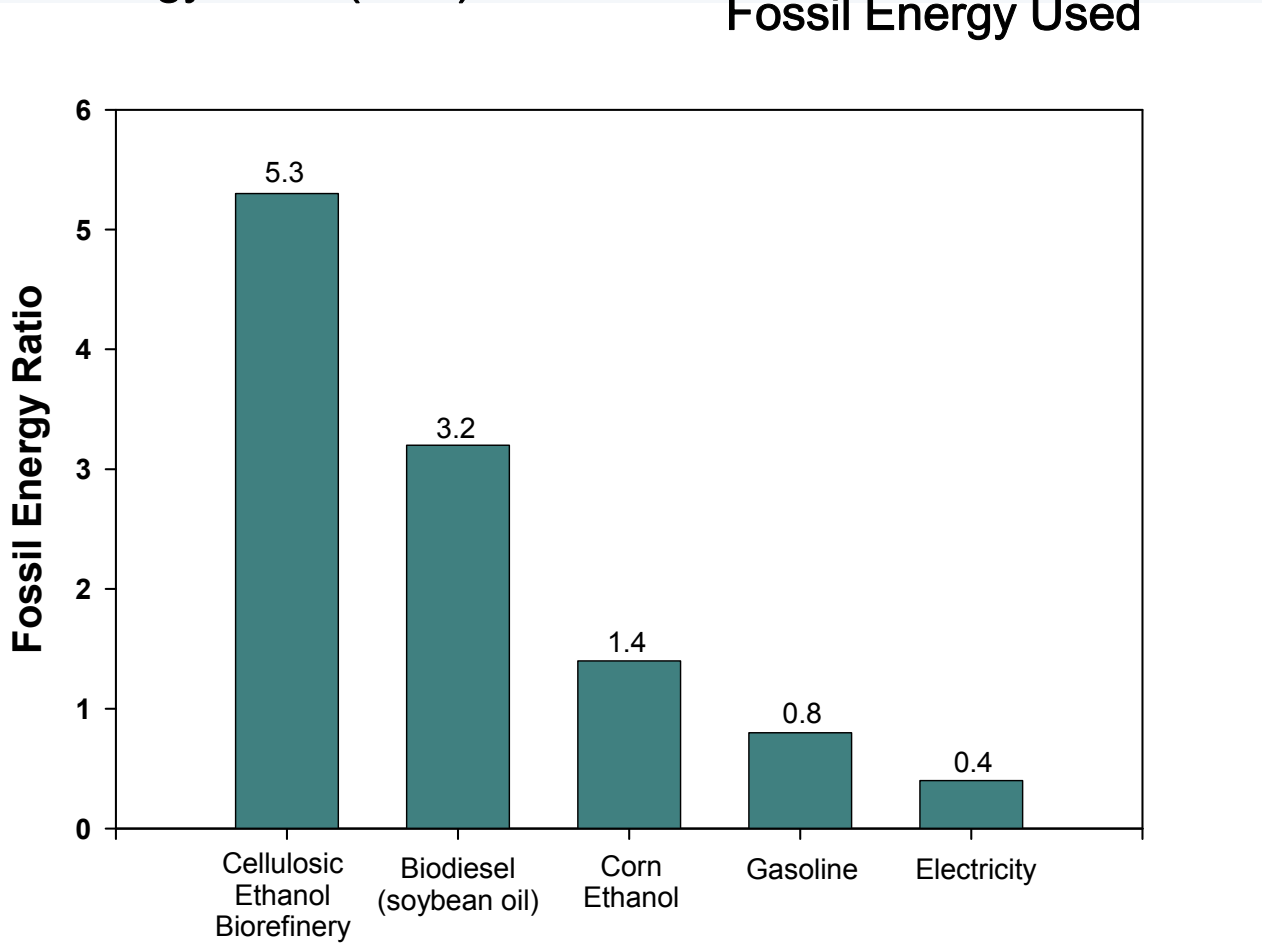
Life Cycle Energy Balance



*ANL, Ethanol, the complete energy lifecycle picture, March 2007

Fossil Energy Ratio

$$\text{Fossil Energy Ratio (FER)} = \frac{\text{Energy Delivered to Customer}}{\text{Fossil Energy Used}}$$



Greenhouse Gas (GHG) Impact*

Replacing a gallon of gasoline with equivalent EtOH

- Corn EtOH using coal as the energy source- approx. 2% increase in GHG's
- Corn EtOH using current energy sources- approx. 15% decrease in GHG's
- Corn EtOH using Natural Gas- approx. 28% decrease in GHG's
- Cellulosic EtOH- approx. 85% decrease in GHG's

*ANL, Ethanol, the complete energy lifecycle picture, March 2007

Flexible Fuel Vehicle Emissions

- Limited data on recent model year vehicles
- Available data currently being reviewed by NREL
- Further testing being completed by NREL, EPA and CRC
- Past data shows for operation on E85:
  - GHG- reduced CO_2 emissions and increased CH_4 emissions
  - Slightly reduced evaporative emissions compared to gasoline
  - Reduced air toxic emissions for benzene and 1,3 butadiene
  - Increased air toxic emissions for acetaldehyde and formaldehyde

NREL E85 Emissions Testing

- Testing being performed at Colorado Department of Public Health and Environment mobile source emissions lab as part of Colorado E85 Coalition initiative
  - Winter E85 (~71% ethanol) and winter gasoline (E10)
  - Summer E85 (~85% ethanol) and summer gasoline (E0)
- Using standard EPA testing requirements and protocol
- Using Colorado state fleet vehicles and possibly EPA fleet vehicles (minimum 5 vehicles)
- All testing to be completed Summer 2007
  - Some of the only available data on recent model year FFVs
- Report to be issued 3rd Qtr 2007